

REMARKS

Claims 1, 3-7, and 13-18 are here amended. Support for the amended claims can be found in the original claims, and in the description as follows. Claim 1 as amended is directed to an apparatus similar to that of original claim 1, with the addition that the predetermined micro-force creating material is a substance and has been added to the cantilever fingers, so that the cantilever fingers deflect in the presence of a predetermined physical property which is a chemical-mechanical microforce present in a test environment. Support for embodiments of the invention concerning the chemical-mechanical micro-force among the variety of physical properties that can be detected is found in claim 2 as originally filed, which has been canceled. Claim 1 as further amended to clarify that the apparatus does not require a source of external power. For support, see the description, page 7, lines 30-31 and page 8, lines 7-9.

The changes in remaining amended dependent apparatus claims are directed to addition of the micro-force creating material to the cantilever fingers, and include changes that have been made for aesthetic purposes and for purposes described below under discussion of the Examiners' rejections under 35 U.S.C. § 112.

Amended claim 14 is directed to a method similar to that described in original claim 14, however comprising in addition a predetermined micro-force-creating material included in cantilever fingers. Support for amended claim 14 can be found in original claim 14, and throughout the description.

New claims 22-35 have been added to more particularly point out and fully claim the scope of the chemical embodiment of the invention.

Claim 22 is directed to a cantilever array block having a plurality of cantilevers having a plurality of cantilever fingers surrounded by a frame with frame fingers, the frame and cantilever fingers forming a diffraction grating to diffract light in response to deflection of the cantilever fingers. The cantilever fingers are comprised of a substrate material from which the cantilevers are formed by general fabrication methods well-known to one of ordinary skill in the field of nanotechnology, and a chemical micro-force creating material which is a predetermined substance, according to this embodiment.

New claim 22 is within the scope of original claims, and is added to indicate that the scope of the original claims, in their novelty, utility and non-obviousness, is not necessarily limited to having a plurality of cantilever array blocks. Support for new claims can be found in the original claims, and throughout the description. Support for new claims and amended claims can also be found in the materials and terms of art well-known to one of ordinary skill in basic modern science and engineering at the time the present invention was made, and includes the fields of chemistry, physics, and biology.

Claims 2, 8-11, and 19-21 have been canceled. Applicants reserve the right to pursue the subject matter of the canceled claims in this or another application claiming benefit of the same priority date as this application.

The claimed invention:

Applicants believe that it would be helpful to first briefly summarize the main points regarding the invention defined by the claims amended herein.

The invention of claims as amended herein is based on methods and devices never before described: microsensors having cantilever fingers and frame fingers that form a diffraction grating, the cantilever fingers comprising a predetermined micro-force creating material capable of interacting with a substance in a test environment, such that the cantilever fingers deflect in the presence of the substance, and incident light is diffracted.

The micro-force creating substance is predetermined; for example, it can be a binding reagent, so that the cantilever fingers deflect and cause incident light to diffract in response to that the substance in the environment reacting with the reagent, such as, the presence of a ligand that binds to the binding reagent on the cantilever fingers. Because no external power source is involved in any aspect of the claimed methods and apparatuses, an arrangement of cantilever fingers surrounded by a frame with frame fingers to form a diffraction grating, with diffraction of light as a sensor for the presence of a physical property in a test environment which can be predetermined by the nature of the micro-force creating material of which the cantilever fingers are comprised, been never before been described.

A change in the position of the cantilever fingers changes the diffraction grating, formed by the cantilever fingers and the frame fingers, in response to a micro-force created on the cantilever fingers, provides visual indicia (a visually perceptible indication) of the

presence of the predetermined micro-force. The visual indicia is a change in color, a change in intensity, or a change in a pattern (see description, page 11, lines 25-30).

The physical property that causes the cantilever fingers to deflect may be, for example, a presence of a chemical substance, a thermal change, a magnetic field, or an electrostatic field. (See the description, page 1, lines 17-21.) In the present claims, the physical property has been limited to a chemical substance. The micro-force creating material on the cantilevers can interact with such a substance, and cause the diffraction grating to diffract light and thereby provide visual indicia of a presence of the physical property.

The micro-force creating material in the embodiment of the invention of the present amended claims, is a predetermined binding reagent, so that in the presence of a predetermined chemical substance which is a ligand of the binding reagent, and the cantilever fingers deflect in response to a chemical-mechanical force created by binding the predetermined substance. The binding reagent can be a biomolecule, for example a protein or a nucleic acid, and can be a protein that is an antigen or an antibody. The effect of binding of a substance causing a predetermined micro-force (cantilever binding) is graphically illustrated in the detailed drawing of Fig.5.

The loading of cantilevers with a chemical substance is illustrated in Fig.4. Methods of loading the cantilever palette are fully enabled (page 8, lines 15-31).

The visual indicia of the original claims has been amended here to more fully describe that the unassisted human eye can detect the yield of spectral information in the form of color, pattern, and/or intensity changes resulting from light diffraction in response to cantilever deflections (page 11, lines 15-30).

The apparatus need not be limited to measuring merely a single physical substance in a single round of measurement. In one embodiment the invention is an apparatus to measure a physical property of a test environment, comprising a first cantilever array block which includes cantilever fingers comprising a first predetermined binding reagent capable of binding to a first substance in the test environment, and a second cantilever array block which includes cantilever fingers comprising a second predetermined binding reagent capable of binding to a second predetermined substance in the test environment.

A surprising aspect of the present invention is that it is entirely self-contained. See the description, page 7, lines 30-31 and page 8, lines 7-9: "... the cantilever palette 20 does not require external power, since the actuation is chemical and mechanical". The cantilever fingers are not oscillated, as is commonly done with cantilever fingers in sensing applications found in prior art.

The claims comply with 35 U.S.C. § 112 Paragraph 2:

The Examiner on page 2 of the Office Action, paragraph 2, rejected claims 1-21, stating that the phrase "each cantilever array block being configured to be responsive to a predetermined micro-force" because it is unclear how the cantilever is so configured.

Applicants have amended and canceled claims to more distinctly describe the embodiments of the invention that the inventors consider their invention, and to advance a finding of allowability. In independent claims 1 and 14, and in other claims which depend from these and which previously included the phrase, "configured to be responsive to a predetermined micro-force," that phrase has been deleted.

Present claims describe cantilever fingers which can deflect in the presence of a substance in a test environment, because the cantilever fingers comprise a micro-force creating material, which material is predetermined by the user. The material causes the cantilever fingers to deflect as a result of a predetermined micro-force that is created on the fingers if a particular chemical substance is present in a test environment, and interacts with the material on the cantilever fingers.

Accordingly, Applicants believe that the claims as amended, convey clear meanings. Applicants respectfully request that the U.S.C. § 112 paragraph 2 rejections be withdrawn.

No express anticipation:

The Examiner rejects of claims 1-3, 5-11 and 13-21 under 35 U.S.C. § 102(a), alleging that the claims are anticipated by Atalar et al. (U.S. patent number 5,980,981). Applicants show here that Atalar et al. is not the same as the inventions of claims 1-3, 5-11 and 13-21 and new claims 22-35, therefore Atalar et al. does not anticipate these claims.

Present claim 1 as here amended and new independent claims describe cantilever fingers which deflect in the presence of a chemical substance in a test environment, because

the cantilever fingers comprise a chemical micro-force creating material, choice of which is predetermined by the user. The material causes the cantilever fingers to deflect as a result of the micro-force created on the fingers when the predetermined chemical substance is present in a test environment, and interacts with the material on the cantilever fingers. Detection in the apparatus of the claims does not require an external power source.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *See Verdegaaal Bros. v. Union Oil of California*, 2 USPQ 2d 1051, 1053, 814 F. 2d 628, 631 (Fed. Cir. 1988); *Mehl/Biophile v. Milgraum*, 52 U.S.P.Q. 2d. 1303, 192 F.3d. 1362 (Fed. Cir. 1999).

Atalar et al., U.S. Patent Number 5,908,981:

Atalar et al. cited by the Examiner on page 2, paragraph 3 of the Office Action shows an improved cantilever tip for an atomic force microscope ("AFM"). The AFM is described as "...operated either in the contact mode, in which the tip rides over the surface, or in the non-contact or attractive mode, in which the resonant frequency of a vibrating cantilever is measured with the tip of the cantilever positioned very near the surface." (Atalar et al., column 1) The tip monitors the surface by a translational x-y motion, to detect the shape or charge of molecules deposited on that surface. We show here that the AFM of Atalar requires external electrical power.

All of the embodiments in Atalar et al. have electrical components that are required in an AFM, as shown in the description. Fig. 6 of Atalar shows a circuit for conventional optical deflection detection in an AFM (see description, column 3, lines 60-61). Fig. 18 shows a circuit for controlling separation by means of electrostatic forces (column 4, lines 30-32). Fig. 20 refers to an AC mode of detection (lines 36-37), and Fig. 28A includes an electrostatic actuator (line 57). (An actuator is required in three of the first seven claims.)

The circuitry produces movement of the tip across the sample. This is illustrated by specification, for example, in referring to Fig. 16 stating, "In cantilever 170, transducer 172 drives both the movable and reference fingers." Fig. 21 is similarly characterized as, "...the frequency of the AC signal is established such that reference fingers 258 and their supporting structure 259 are driven by electrostatic forces to oscillate at their resonant frequency."

Atalar's apparatus is an electronic device having actuators and detectors required for, inter

alia, producing oscillation of cantilevers, and is not a mechanical device as in the present invention.

Because of these differences, Atalar et al. is not the same as the present invention. Because Atalar et al. relates to an AFM having electronic components and a cantilever with a tip and an unmodified surface, and the present claims are directed to an entirely different type of sensor apparatus, Atalar et al. does not anticipate the device and methods of the present invention.

Applicants respectfully urge the Examiner to withdraw rejection of claims in view of Atalar et al. on the basis of 35 U.S.C. §102.

The claimed invention would not have been obvious to one of ordinary skill in the art in light of the cited references:

The Examiner on page 3, paragraph 7 of the Office Action, rejects claims 4 and 12 as obvious over Atalar et al. in view of Lee et al., U.S. patent number 5,807,758). For the reasons shown below, the subject matter of the claims would not have been obvious in light of the prior art of record. In particular, the subject matter of the claims now pending in the application is neither taught nor suggested by the references of record, Atalar et al. and Lee et al., alone or in combination.

The courts in *In re Vaeck*, 20 U.S.P.Q. 2d 1438, 947 F.2d 488 (Fed. Cir. 1991), *In re Bell*, 26 U.S.P.Q. 2d 1529, 991 F. 2d. 781 (Fed. Cir. 1993), and in *Hybritech v. Monoclonal Antibodies*, 231 U.S.P.Q. 81, 802 F. 2d 1367 (F. Cir. 1986) state that a first question in deciding whether a *prima facie* case of obviousness can be made is whether the references suggest the invention.

To establish a *prima facie* case of obviousness, it must be shown: first, that there is some suggestion or motivation, either in the reference or in the knowledge cited available to one of ordinary skill in the art, at the time the invention was made, to modify the reference to obtain the invention and second, that the prior art reference teaches or suggests all the limitations of the claim. (Manual of Patent Examining Procedure, 2:2143). Atalar et al. and the other references fail to satisfy these criteria, alone or in any combination, therefore a *prima facie* case of obviousness has not been made. Neither of the two cited references refers to the other. On this basis, rejection of claim in light of Atalar et al. (U.S. patent number

5,908,981) and further in view of Lee et al. (U.S. patent number 5,807,758) on the basis of 35 U.S.C. §103(a) is improper.

Further, Lee et al. fails to supply the deficiencies of Atalar et al., which has been characterized above. For the Examiners' convenience, Lee et al. will be first characterized, then these references will be considered in combination.

Lee et al. (U.S. patent number 5,807,758):

Lee et al. uses a readout supplied by perturbation of a required external field, either a magnetic field (see Lee et al., col. 4), or an electric field (*Id.*, col. 5), for the purpose of providing sensors. The target molecule can be detected in a magnetic field if it has a magnetic or paramagnetic bead. "Paramagnetic beads are desired" for this embodiment of Lee et al., "because the beads will have a magnetization only when an external field is applied." See col. 4, lines 64-66. The electric field embodiment uses "a cantilever having attached chemical groups, disposed in an electric field" (col. 5, lines 36-37). The invention of Lee et al. is dependent upon application of an external electro-magnetic field. Thus, Lee et al. requires an external power supply.

Lee et al. does not supply the deficiencies of Atalar et al. Thus Lee et al. does not teach or show diffraction of light as a sensor to indicate cantilever finger deflection. Lee et al. nowhere provides cantilever fingers and frame fingers that comprise a diffraction grating capable of diffracting light. Lee et al. neither teaches nor suggests changes in diffraction of light as a readout. As Lee et al. requires application of an external field, either magnetic or electrical, this reference in fact teaches away from the present invention which does not require external power. (See the present description page 7, lines 30-31).

As shown above, Atalar requires an electronic source, and therefore teaches away from the present invention. Lee neither teaches nor suggests removing the electronics from Atalar et al., since external power is required in Lee et al. Since Lee et al. fails to supply the elements of the invention missing in Atalar et al., viz., a diffraction grating for diffraction of light formed by cantilever fingers and frame fingers and not requiring electronics, and since both patents teach away from the present invention by requiring electronics, Lee et al. alone or in combination with Atalar et al. fails to teach or suggest, and therefore fails to render obvious, the inventions embodied in the claims as here amended.

When there are no specific teachings in the cited art, such art cannot form the basis of a rejection for obviousness. “A general incentive does not make obvious a particular result, nor does the existence of techniques by which those efforts can be carried out.” *See In re Deuel*, 34 U.S.P.Q. 2d 1210, 1216, 51 F. 3d 1552 (Fed. Cir. 1995) following *In re O’Farrell*, 7 U.S.P.Q. 2d 1673, 1680-1681, 853 F. 2d 1673 (Fed. Cir. 1988).

“Obviousness ‘cannot be established by combining teachings of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination.’ “ *In re Bell*, 26 U.S.P.Q. 2d 1529, 1531, 991 F.2d 781 (Fed. Cir. 1993, citing *In re Fine*, 5 U.S.P.Q. 2d 1529, 837 F. 2d 1071 (Fed. Cir. 1988), which in turn was citing *A.C.S. Hospital System v. Montefiore Hospital*, 221 U.S.P.Q. 215, 732 F. 2d 1571, (Fed. Cir. 1984)). [Emphasis added.]

None of these references suggests an apparatus for identification of a physical property of a test environment that uses diffraction of light by a grating comprising cantilever fingers and frame fingers as a sensor of deflection of the cantilever fingers. Both of the cited references show only electrically connected cantilevers. Neither of the cited references suggests the need for the invention of the present claims, let alone teaches how to achieve an apparatus that uses diffraction of incident light by forming a diffraction grating of cantilever fingers and frame fingers. Neither of Atalar et al. nor Lee et al. has rendered obvious any of the embodiments of the present invention for at least the reason that none even provides a general incentive to make the apparatus and methods of the present claims.

Most important, none of the references direct the artisan of ordinary skill to the other references that in combination are asserted to render obvious the invention of the present claims.

In applying these standards to the present invention, factual analysis indicates that none of the references cited provides teachings or suggestions that direct one of ordinary skill in art, at the time the present invention was made, to the other references cited. While Atalar et al. and Lee et al. provide cantilevers, the references provide no suggestion of any specific directions that would have enabled one of ordinary skill to combine these references to achieve the invention embodied in the present claims. By standards of the established case law, Applicants’ invention would not have been obvious in view of the combination of references.

Moreover, that a method may be “obvious to try”, is not a basis for rejection under 35 U.S.C. §103. See *In re O’Farrell*, 7 U.S.P.Q. 2d 1673, 1680-1681, 853 F. 2d 1673 (Fed. Cir. 1988). A reference must not only suggest additions or modifications, but the reference must also suggest that such changes would be successful. *In re O’Farrell*, 7 U.S.P.Q. 2d 1673, 1680-1681, 853 F. 2d 1673 (Fed. Cir. 1988).

The subject matter defined by the present claims would not have been obvious in view of any of the cited references, alone or in combination. Embodiments of Applicants’ invention provide a degree of success that is novel and even spectacular in view of this prior art. No free standing passive apparatus, devoid of a source of voltage, or not powered by an electric or a magnetic field, was taught or suggested by Atalar et al. or by Lee et al.

As stated in *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q. 2d 1438 (Fed. Cir. 1991), “. . . both suggestion and reasonable suggestion of success must be found in the prior art, not in Applicant’s disclosure.” It is improper for the Examiner to reconstruct the invention by using the application as a blueprint by which to join unrelated prior art.

In this case, none of these prior art references even mentions, let alone suggests, the element of all of the present claims, viz., a diffraction grating that diffracts light in response to deflection of cantilever fingers, without external electric power. None of the references suggests simply having cantilever fingers surrounded by frame fingers that form a diffraction grating to diffract light and indicate deflection of the cantilever fingers, without external power.

Instead, the prior art references here do not use light at all (Lee et al.), or use light that is merely reflected differentially by wavelength in the usual manner by which color is produced (Atalar et al). Lee et al. does not supply the deficiency of Atalar et al. Neither teach nor suggest the present claims, nor suggest a combination with the other reference, nor suggest that such a combination would be successful. Therefore the invention is not obvious in light of the combination of Atalar et al. with Lee et al.

Applicants respectfully request that the Examiner withdraw rejection of the claims under 35 U.S.C. §103.

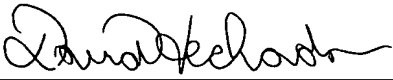
Conclusion:

In view of the foregoing amendments and remarks, Applicants submit that the claims are now in condition for allowance. Early and favorable reconsideration of the application is therefore respectfully solicited.

Should the Examiner feel that a telephone conference would advance prosecution of the present application, he is invited to call the undersigned attorney at the number listed below.

Respectfully submitted,

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